microSpan® 3040G PULSE OXIMETER

OPERATOR'S MANUAL

BIOCHEM

BIOCHEM INTERNATIONAL INC.

Warnings

Federal law restricts the use or sale of this device by, or on the order of, a physician.

Verify that the 3040G Oximeter is set to the proper AC line voltage setting for your installation. The AC line voltage setting is shown on the rear panel of the 3040G Oximeter. If the AC line voltage setting is incorrect, do not use the 3040G Oximeter. Contact an authorized service center.

The 3040G Oximeter is intended for use by persons trained in professional health care. The operator must be thoroughly familiar with the information in this manual before using the instrument.

This device should not be used in the presence of flammable anesthetics.

Operation may be affected in the presence of strong electromagnetic sources, such as electrosurgery equipment.

Operation may be affected in the presence of imaging equipment, such as Magnetic Resonance Imaging (MRI), and Computed Tomagraph (CT) devices, etc. It is the facility's responsibility to verify performance prior to installing equipment in any of these environments.

Do not autoclave, ethylene oxide sterilize, or immerse in liquid. Unplug before cleaning or disinfecting.

Significant levels of dysfunctional hemoglobins, such as carboxyhemoglogin or methemoglobin, will affect the accuracy of the SaO2 measurement.

Operation may be affected in the presence of high ambient light. Shield the probe area (with a surgical towel, for example) if necessary.

Dyes introduced into the bloodstream, such as methylene blue, indocyanine green, indigo carmine, and flourescein, may cause an inability to determine accurate SaO2 readings.

Any condition which restricts blood flow, such as use of a blood pressure cuff or extremes in systemic vascular resistance, may cause an inability to determine accurate pulse and SaO2 readings.

WARNING: ELECTRICAL SHOCK HAZARD when covers are removed. Do not remove covers. Refer servicing to qualified personnel.

Proprietary Notice

Information contained in this document is copyrighted by Biochem International Inc. and may not be duplicated in full or part by any person without prior written approval of Biochem International Inc. Its purpose is to provide the user with adequately detailed documentation to efficiently install, operate, maintain, and order spare parts for the equipment supplied. Every effort has been made to keep the information contained in this document current and accurate as of the date of publication or revision. However, no guarantee is given or implied that the document is error free or that it is accurate with regard to any specification.

Limited Warranty

Biochem International Inc. warrants each new Oximeter to be free from defects in workmanship and materials under normal use and service for a period of one (1) year from the date of shipment, and sensors and patient cables for a period of 90 days from shipment. Biochem International Inc.´s sole obligation under this warranty will be to repair or replace, at its option, products which prove to be defective during the warranty period. The foregoing shall be the sole warranty remedy. Except as set forth herein, seller makes no warranties, either expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. No warranty is provided if the products are modified without the express written consent of Biochem International Inc., and seller shall not be liable in any event for incidental or consequential damage. This warranty is not assignable.

Service Support

Repairs of Biochem International Inc.´s instruments under warranty must take place at authorized service centers. When calling Biochem to request service, have your monitor´s model and serial number ready. If you need to ship the monitor, special packing is required to prevent shipping damage. All accessories should accompany the instrument and shipping costs must be prepaid.

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General Description

The Biochem microSpan 3040G Pulse Oximeter is a portable, compact, and lightweight monitor that noninvasively and continuously monitors arterial blood oxygen saturation (SaO2) and pulse rate.

SaO2 and pulse rate information is conveyed both visually and audibly. A custom high contrast Liquid Crystal Display (LCD) with Electroluminescent (EL) backlighting indicates the SaO2, pulse rate, pulse signal strength, and system messages. The monitor's tone generator "beeps" with each pulse beat. The pulse "beep" momentarily changes to a lower-tone double "beep" when there is a decrease in SaO2.

The 3040G Oximeter has a flexible alarm system with audible and visual indicators. The high and low alarm limits for SaO2 and pulse rate are user adjustable. The audible alarm and pulse "beep" volume can be adjusted or inhibited by the user.

The 3040G Oximeter operates on power from the AC line or its internal battery.

Theory of Operation

The 3040G Oximeter determines SaO2 and pulse rate by passing two wavelengths of light, one red and one infrared, through body tissue to a photodetector. Pulse identification is accomplished by using plethysmographic techniques, and oxygen saturation measurements are determined using spectrophotometric oximetry principles. During measurement, the signal strength resulting from each light source depends on the color and thickness of the body tissue, the sensor placement, the intensity of the light sources, and the absorption of the arterial and venous blood (including the time varying effects of the pulse) in the body tissues.

The 3040G Oximeter processes these signals, separating the time invariant parameters (tissue thickness, skin color, light intensity, and venous blood) from the time variant parameters (arterial volume and SaO2) to identify the pulse and calculate oxygen saturation. Oxygen saturation calculations can be performed because blood saturated with oxygen predictably absorbs less red light than oxygen depleted blood.

Since measurement of SaO2 depends on a pulsating vascular bed, any condition which restricts blood flow, such as use of a blood pressure cuff or extremes in systemic vascular resistance, may cause an inability to determine accurate pulse and SaO2 readings.

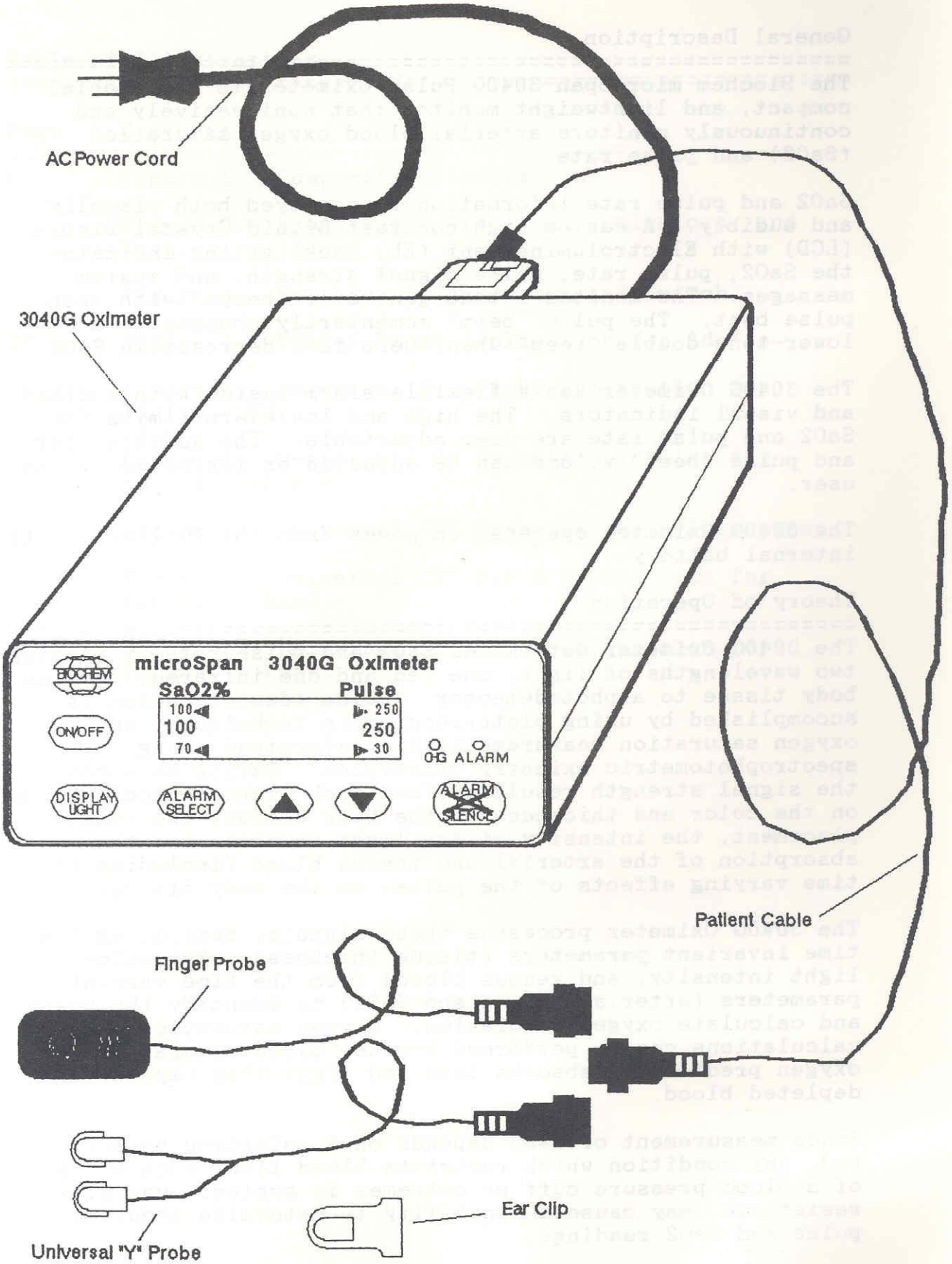

Figure 1. Composite Illustration.

Front Panel Displays, Indicators, and Keys

A high contrast LCD with EL backlighting provides a comprehensive visual interface with the 3040G Oximeter. Touchpad keys control the 3040G Oximeter. Refer to Figure 2.

Item		Description
1	SaO2% Pulse Rate	SaO2 and Pulse Rate are shown in large numerals. Smaller numerals show the high alarm limit (above) and low alarm limit (below) each display.
2	Triangular Indicators	The triangular indicators point to the alarm limits to indicate the alarm is selected for setting or flash to indicate the alarm limit has been violated. "H" indicates high and "L" indicates low alarm limit.
3	Bargraph	The vertical bargraph has eight segments to display pulse activity and strength. The bargraph is logarithmically scaled to indicate a wide range of pulse strengths.
4	LOW BATT	Indicates the battery voltage is low.
	LOW PULSE	The pulse level is low enough that the reading may be unreliable. May indicate improper probe positioning.
	PULSE SEARCH	The monitor is automatically adjusting signal processing and probe LED drive levels to achieve acceptable signal levels, and is interpreting the signal to detect the pulse.
	ALARM	Indicates the alarm volume is being adjusted with the Up/Down arrow keys.
	BEEP	Indicates the pulse "beep" volume is being adjusted with the Up/Down arrow keys.
	ALARM SILENCED	Flashing indicates the alarm has been silenced with automatic two minute reset. Not flashing (continuous) indicates the alarm has been silenced indefinitely.
	BEEP SILENCED	This is displayed for 1-2 seconds when the pulse "beep" volume is adjusted to off.
	CHECK SENSOR	Indicates the probe is off the patient, needs to be repositioned on the patient, or is not connected to the monitor.

5	ON/OFF	Turns the monitor on and off. The internal battery charger is on when AC power is supplied and the BATTERY switch is in the NORMAL position.
6	DISPLAY LIGHT	Toggles the display backlight on and off.
7	ALARM SELECT	Pressing ALARM SELECT steps through each of the four alarm limits for setting, and back to none selected. If either the Up/Down arrows or the ALARM SELECT key is not pressed for approximately 20 seconds, the monitor returns to none selected.
8	Up/Down Arrows	When an alarm limit is not selected, these keys increase/decrease either the alarm volume (when the alarm is not silenced) or the pulse "beep" volume (when the alarm is silenced). When an alarm limit is selected, these keys control scrolling up and down through the alarm limits' setting. The Up/Down Arrow keys are also used to select 4 or 16 pulse averaging for %SaO2 measurement (the default is 8 pulse averaging). Refer to the "Starting" section on page 13 for details.
9	ALARM SILENCE	Pressing ALARM SILENCE turns the audible alarm off for two minutes or until ALARM SILENCE is pressed again. Pressing and holding ALARM SILENCE for 3 seconds turns the alarm off until ALARM SILENCE is pressed again or the monitor is turned off and on.
10	ALARM	The red "ALARM" LED indicates a patient or system alarm. The LED flashes or remains steady depending on the alarm condition. See Alarms and Indicators on page 12.
11	CHG	The green "CHG" LED indicates the battery is charging.

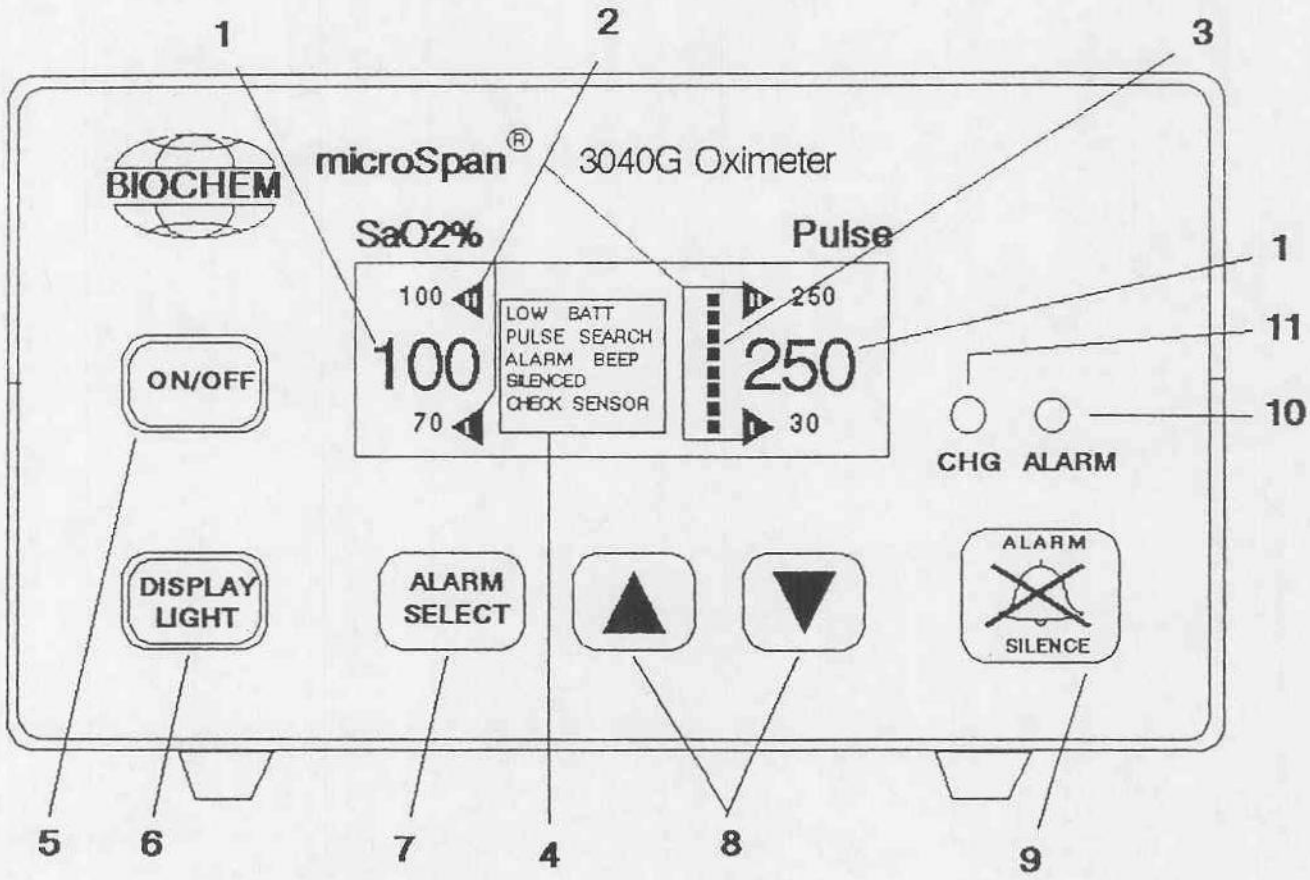

Figure 2. Front Panel Displays, Indicators and Keys.

Rear Panel Connectors and Switch

Refer to Figure 3.

	Label	Description
1	PATIENT CABLE/PROBE	The Patient Cable is typically plugged into this connector. The Finger and Universal "Y" adapter probes may be directly plugged into this connector if the additional length of the patient cable is not required.
2	BATTERY	The BATTERY switch is set to NORMAL for operation and DISCONNECTED for shipping and long-term storage. The battery is charging when the green "CHG" LED on the front panel is lit.
3	SERIAL DATA	The 3040G Oximeter is interfaced to the optional 3045 microSpan "Smart" printer through this connector. The 3040G Oximeter can be interfaced to any computer that supports the 3040G communication protocol and whose serial input port responds to 0-5 V levels. 3040G communication protocol information is in the microSpan 3040G Oximeter Service Manual.
4	VAC RATING	This is the AC line voltage input setting and current rating. Verify that the 3040G Oximeter is set to the proper AC line voltage setting for your installation. If the AC line voltage setting is incorrect, do not use the 3040G Oximeter. Contact an authorized service center.
5	AC LINE	The AC Power Cord is plugged into this connector.
6	PULSE RATE	The PULSE RATE from 0-250 beats/minute is represented as 0.00 VDC to 2.50 VDC.
7	SaO2	The SaO2 level from 0 to 100% is represented as 0.00 VDC to 1.00 VDC.
8	PLETH.	The PLETH. (plethysmogram) is represented as 0.00 V to 2.55 V centered at 1.28 V.

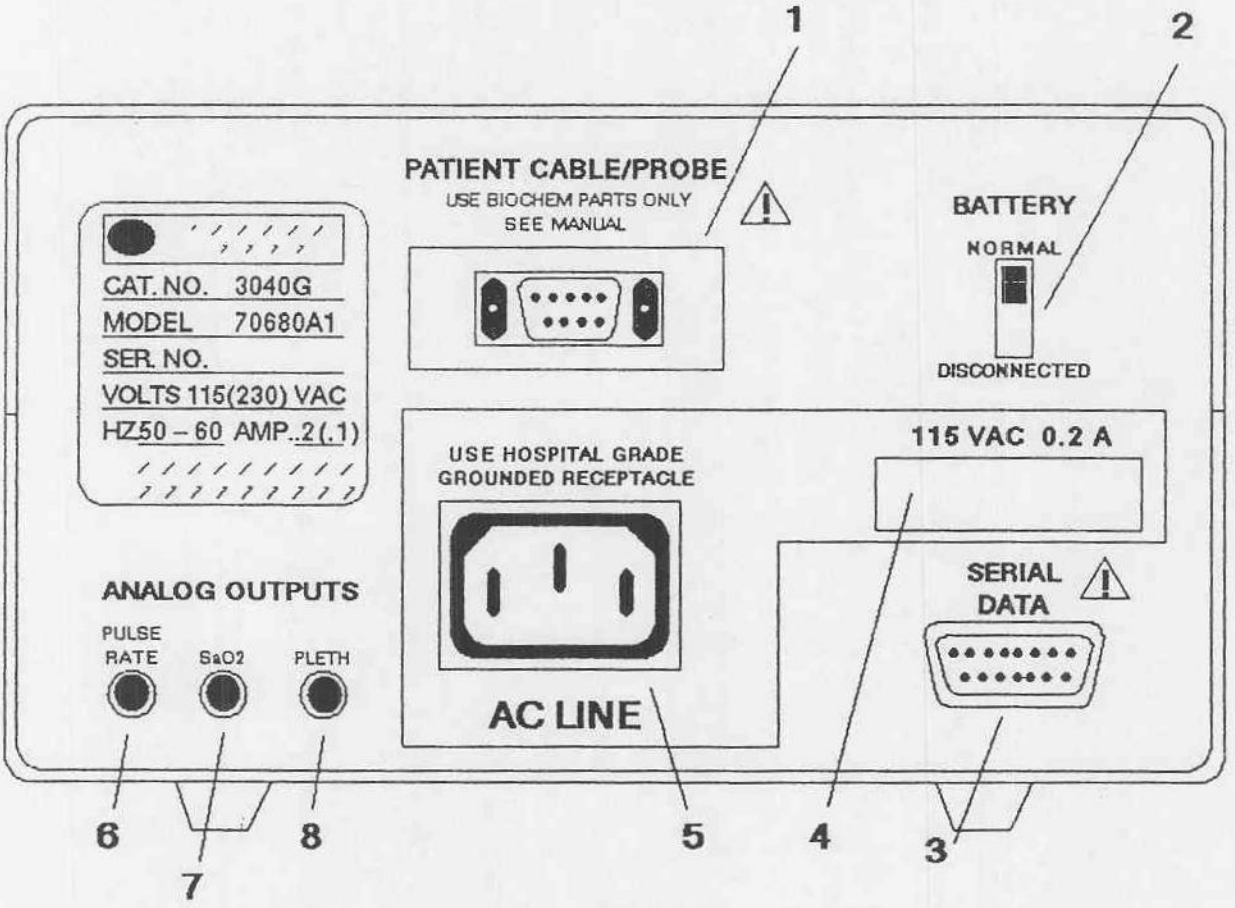

Figure 3. Rear Panel Connectors and Switch.

Alarms and Indicators

Patient Alarms and Indicators

Condition	Alarm/Indicator
Pulse Beat Detect	A short "beep" sounds each time a pulse beat is detected. The volume is adjustable (including off) independently from the alarm volume.
Matched or Exceeded Alarm Limit	A two-tone alarm sounds (when the alarm is not silenced), the red "ALARM" LED flashes, and the triangular indicator for the violated alarm limit flashes.
Low Pulse Amplitude	LOW PULSE is displayed.
Drop in SaO2	A lower-tone double "beep" sounds.

System Alarms and Indicators

Condition	Alarm/Indicator
Probe Off Patient or not Connected to Monitor	A double "beep" sounds every second (when the alarm is not silenced), CHECK SENSOR is displayed, and the red "ALARM" LED lights continuously.
Searching too long for Pulse	A double "beep" sounds every second (when the alarm is not silenced), PULSE SEARCH is displayed, and the red "ALARM" LED lights continuously.
Low Battery Voltage	A short burst of "beeps" sounds when a low battery voltage condition is first detected. LOW BATT is displayed continuously.
Battery Charging	The green "CHG" LED is lit.

Using the 3040G Oximeter

Setting Up

Set the BATTERY switch (on the rear of the monitor) to NORMAL. If AC power is available, connect the AC Power cord to the AC LINE connector on the 3040G Oximeter and then to a hospital grade outlet.

Connect the patient cable to the PATIENT CABLE/PROBE connector on the rear of the 3040G Oximeter.

Refer to Figures 4-9 and choose either the Finger Probe or the Universal "Y" Probe for use based on application requirements.

Connect the probe to the Patient Cable.

Caution: Use only Biochem Finger Probe, Catalog No. 3044 or Universal "Y" Probe, Catalog No. 3043, with the microSpan 3040G Oximeter.

Starting

Press the front panel On/Off key. The 3040G Oximeter performs a self-test, lights all display legends, and displays the software revision. The 3040G Oximeter then enters the monitoring mode.

The 3040G Oximeter defaults to an eight (8) pulse averaging mode for SaO2 measurement, but four (4) or sixteen (16) pulse averaging is available. To put the monitor in the 4 pulse averaging mode, press and hold the DOWN arrow key while turning the monitor on. The number 4 appears for a moment in the SaO2 portion of the LCD display. To put the monitor in the 16 pulse averaging mode, press and hold the UP arrow key while turning the monitor on. The number 16 appears for a moment in the SaO2 portion of the LCD display. To return the monitor to the 8 pulse averaging mode, turn the monitor off and on.

The 3040G Oximeter uses an 8 second pulse rate average in the 4 or 8 pulse SaO2 averaging mode and a 16 second pulse rate average in the 16 pulse SaO2 averaging mode.

Attaching the Sensor

Both the Finger Probe and the Universal "Y" Probes are reuseable. See the "User's Maintenance" section on page 17 for probe cleaning instructions.

Finger Probe: Attach the probe to the finger as shown in Figure 4 so the cable protrudes along the palm of the hand. Very long finger nails may make positioning of the probe difficult, resulting in a poor pulse signal. Use the Universal "Y" Probe, as shown in Figure 6, for patients with very long finger nails.

Universal "Y" Probe: Attach the probe to the patient as shown in Figures 5, 6, 8, or 9, using adhesive strips as necessary. When using the Universal "Y" Probe on the finger, attach the LED (light source) portion of the sensor to the finger nail side of the finger.

Ear Probe Attachment: The Universal "Y" Probe can be adapted for use as an ear probe with the Ear Clip. The Universal "Y" Probe is attached to the Ear Clip as shown in Figure 7. The Ear Clip is then attached to the patient's ear lobe as shown in Figure 5.

Verifying the Sensor Placement

Once the probe is attached to the patient, allow several pulse beats for the monitor to stabilize. Observe the pulse bar graph located on the LCD Display. If the pulse signal strength is low, the probe position may need adjustment.

Measuring the Pulse Rate and SaO2

After approximately four or five pulse beats, the Pulse Rate and SaO2 values are displayed.

The pulse "beep" sounds with each pulse beat when the pulse tone is enabled.

A lower-tone double "beep" sounds when a drop in SaO2 is detected.

Setting the Alarms

Alarms are still active while setting, but the "H" and "L" triangular indicators do not flash for violated alarms. The "H" and "L" trianglular indicators act as a cursor to identify the limit selected for adjustment.

Press the ALARM SELECT key until the cursor is positioned at the alarm parameter you are setting (High SaO2, Low SaO2, High Pulse Rate, Low Pulse Rate).

Press the Up/Down arrow keys to increase or decrease the selected alarm value. "--" in the alarm display indicates the alarm parameter is set to OFF.

Note: The alarms in the 3040G Oximeter are non-overlapping. You cannot set the low alarm higher than the high alarm or the high alarm lower than the low alarm.

Interpreting the Patient Alarms

When an alarm limit is violated, a two-tone alarm sounds (when the alarm is not silenced), the red "ALARM" LED flashes, and the triangular indicator for the violated alarm limit flashes. The alarms stop when the alarm limit is no longer violated.

Press the ALARM SILENCE key to silence the alarm for two (2) minutes. ALARM SILENCED flashes on the display. Press the ALARM SILENCE key again to end the two minute alarm silence.

Press and hold the ALARM SILENCE key for three (3) seconds to silence the alarm indefinitely. ALARM SILENCED is displayed continuously. Press the ALARM SILENCE key again to end the indefinite alarm silence mode.

LOW PULSE is displayed when the pulse amplitude is low.

A lower-tone double "beep" sounds when a drop in SaO2 is detected.

Adjusting the Audio Volume

Alarms: Use the Up/Down arrow keys to adjust the audio alarm volume (when not setting the alarm limits and the alarm is not silenced).

Pulse "Beep": Silence the audio alarms by pressing the ALARM SILENCE key (be sure ALARM SILENCED is displayed). Now use the Up/Down arrow keys to set the pulse "beep" volume (when not setting the alarm limits). BEEP SILENCED is momentarily displayed when the pulse "beep" volume reaches off.

Stopping

Press the front panel On/Off key to turn the monitor off. If the green "CHG" LED is lit, the battery charging circuit is recharging the battery.

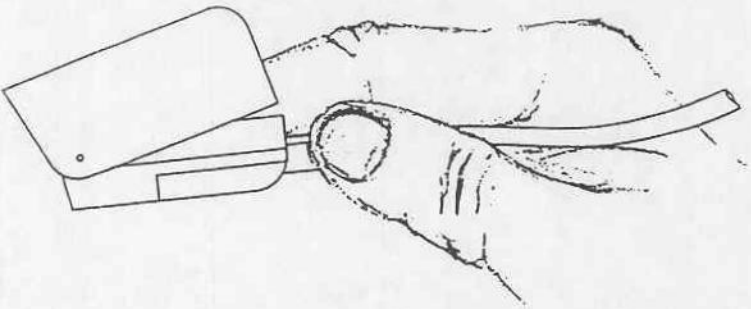

Figure 4. Finger Probe Application for Adults.

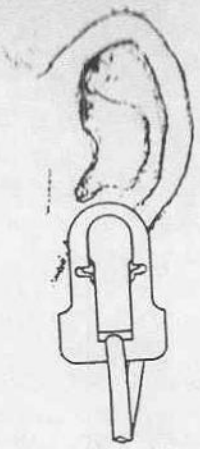

Figure 5. Universal "Y" Probe Application for Adults - Ear.

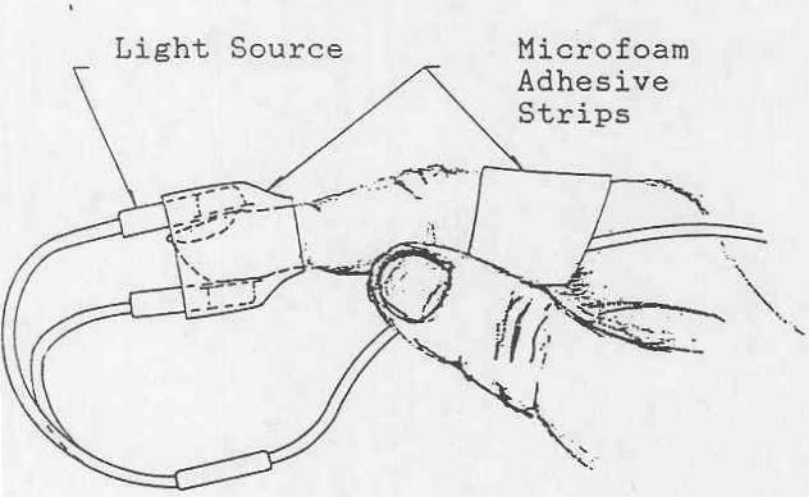

Figure 6. Universal "Y" Probe Application for Adults - Finger.

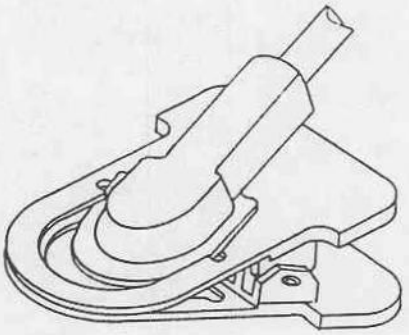

Figure 7. Universal "Y" Probe Ear Clip Attachment.

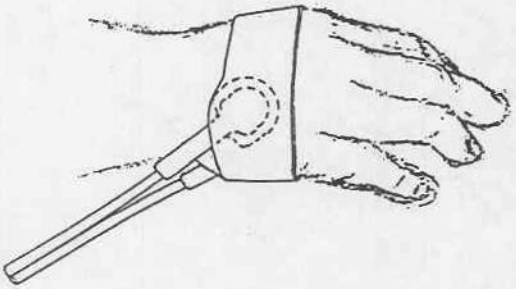

Figure 8. Universal "Y" Probe Application for Infants - Hand.

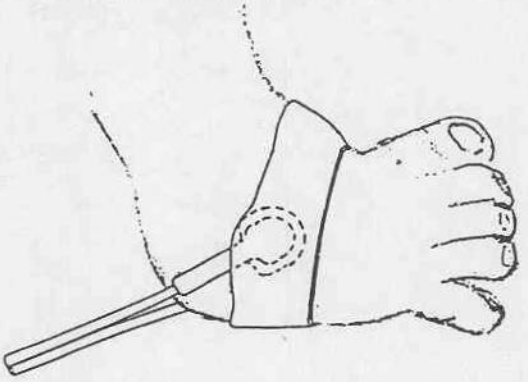

Figure 9. Universal "Y" Probe Application for Infants - Foot.

User's Maintenance

The microSpan 3040G Oximeter and probes do not require routine maintenance other than charging the battery. The battery should be charged after the 3040G is used under battery operation, when the BATT LOW message is displayed on the LCD, or after long term storage. If the 3040G Oximeter requires service, see the "Servicing the Monitor" section on page 18.

Cleaning and Disinfecting

CAUTION: Do not immerse the 3040G Oximeter or probes in liquid. Do not autoclave or ethylene oxide sterilize the 3040G Oximeter or probes. Unplug the AC power cord before cleaning or disinfecting the 3040G Oximeter or probes.

Clean the surfaces of the microSpan 3040G Oximeter and probes with a soft cloth moistened in a mild soap solution. If disinfection is required, wipe the surfaces with isopropyl alcohol or glutaraldehyde.

Charging the Battery

Connect the AC Power Cord to the AC LINE connector on the 3040G Oximeter and then to a hospital grade outlet. Set the BATTERY switch (on the rear of the 3040G Oximeter) to NORMAL. Verify the green "CHG" LED is lit.
Ten hours of charging (with the monitor OFF) fully charges the battery. A fully charged battery generally provides 4 hours of operation (5 hours with the backlight OFF).

Long Term Storage

Storage Facility	Indoor
Temperature	50-105 degrees F
Relative Humidity	10-90%
Preservation	Storage Temp. / Charging interval 65 degrees F / every 12 months 85 degrees F / every 6 months 105 degrees F / every 3 months
Periodic Inspection	None required.
Special Procedures	Set the rear panel BATTERY switch to the DISCONNECTED position. Store the 3040G Oximeter and accessories in the original packing materials and shipping carton.

Servicing the Monitor

If your microSpan 3040G Oximeter is not fuctioning properly, refer to the "Troubleshooting Guide" below. If your 3040G Oximeter is still not functioning properly, do not use your 3040G Oximeter until it has been properly serviced. Refer to the "Service Support" section on page 2.

Troubleshooting Guide

Symptom	Possible Cause
LCD Display does not light.	BATTERY switch in DISCONNECTED position. If operating on battery, battery may need charging or replacement. Blown fuse in monitor.
CHARGE LED not lit.	AC Power Cord disconnected. BATTERY switch in DISCONNECTED position.
No pulse registering on bargraph.	Sensor or patient cable disconnected from monitor. Incorrect positioning of sensor. Poor patient perfusion. Defective sensor or patient cable.
Pulse rate erratic, intermittent, or incorrect.	Incorrect positioning of sensor. Poor patient perfusion. Patient motion.
E0, E1, or E2 is displayed on the LCD.	These are diagnostic messages. Refer servicing to qualified personnel.

Supplies and Accessories

Standard Supplies and Accessories

Catalog No.	Qty.	Description
3040G	1	microSpan Oximeter
3043	1	Universal "Y" Probe
3044	1	Finger Probe
3047	1	Patient Cable (10 ft.)
3046	1	AC Power Cord
3042	1	Ear Clip for Universal "Y" Probe
3053	1	3040G Oximeter Operator's Manual
3054	1	3040G Oximeter Service Manual
	1	Microfoam Adhesive Strips Starter Kit

Optional Supplies and Accessories

Catalog No.	Qty.	Description
3049	1	Microfoam Adhesive Strips
3056	1	3040G Oximeter Carrying Case
3057	1	3040G Oximeter Litter Mount
3058	1	3040G Oximeter Pole Mount
3045	1	microSpan "Smart" Printer
3062	1	3040G Operator's Training Manual
3063	1	3040G Operator's Training Instructor's Manual
3059	1	3040G Service Training Manual
3051	1	3040G Service Training Instructor's Manual

Product Specifications

General

Display	LCD with Electro Luminescent (EL) Backlight. Large digital display of SaO2 & Pulse Rate. Continuous display of high/low alarm limits. Pulse strength activity logarithmic bargraph.	
SaO2	User selectable 8, 4, or 16 beat average.	
Range	0-100%	
Accuracy	+/- 2% at 70-100%	
	+/- 3% at 50-69%	
Alarm Ranges	Low	50-99% (in 1% steps) and OFF
	High	50-100% (in 1% steps) and OFF
Pulse Rate	8 second pulse rate averaging with 4 or 8 beat SaO2 averaging. 16 second pulse rate averaging with 16 beat SaO2 averaging.	
Range	30-254 bpm	
Accuracy	+/- 2% at 30-100 bpm	
Alarm Ranges	Low	5-195 (in 5 bpm steps) and OFF
	High	5-250 (in 5 bpm steps) and OFF

Inputs/Outputs

Digital	Serial - SaO2, Pulse Rate, Signal Strength, Plethysmogram, status indication, alarm settings, and trend data in response to single character commands. Can output 9 hour trend of SaO2, pulse rate, pulse strength, and event data.	
Analog	SaO2	0-100% = 0-1.00 VDC
	Pulse Rate	30-254 bpm = 0.30-2.54 VDC
	Plethysmogram	0-2.55 VDC. Centered at 1.28 VDC.

Power Requirements

AC Input	115 VAC 50/60Hz 0.2 A
	230 VAC 50/60Hz 0.1 A
Battery	4 to 5 hour operation with 10 hour recharge.
Dimensions	Height = 4", Width = 6.5", Depth = 9.5"
Weight	4 lbs. 8 oz.

Environmental Specifications

Temperature	50-105 degrees F (operating)
	40-110 degrees F (storage)
Relative Humidity	20-80 % (operating)
	10-90% (storage)